

## REMARKS/ARGUMENT

In the most recent Office Action, claims 1, 3-6, 8-13 and 20-22 were examined. Claims 1, 3-6, 8-13 and 20-22 are rejected. Claim 4 is amended. No new matter is added.

### Claim Rejections - 35 U.S.C. §103

Claims 1, 3-6, 8-13 and 20-22 are rejected under 35 U.S.C. §103(a) as being obvious over Floyd et al. (U.S. Patent No. 6,090,716). In particular, the Office Action states that Floyd et al. disclose all of the elements of the claimed invention with the exception of a reverse polarity type device. The Office Action further states that a MOSFET device and a one polarity also normally works with reverse polarity, thereby making the present invention obvious over the disclosure by Floyd et al. In addition, the Office Action notes that Applicant's claim of unexpected results is unpersuasive because, "the advantages obtained in the present invention would flow naturally from the MOSFET device of Floyd ... after the polarity [is] reversed." Applicant respectfully traverses this rejection.

Applicant respectfully disagrees with the conclusion in the Office Action that a MOSFET design that works under one polarity type is normally also workable under the reverse polarity type. As stated in the present application, it is known that holes have a lower carrier mobility in silicon than do electrons. Accordingly, in a P-channel device, the number of holes in a path should be maximized to reduce the ON resistance  $R_{dson}$ , while the resistive path should be minimized. By reducing the channel length and the associated resistance, the value of  $R_{dson}$  and the switching losses related to the channel capacitance can also be reduced.

Accordingly, if, as asserted in the Office Action, the device by Floyd et al. were reversed in polarity, Applicant submits that one of ordinary skill in the art would expect to have a higher ON resistance  $R_{dson}$  due to the attendant reduction in carrier mobility when switching from an N channel type device to a P-channel type device. As noted in the background of the present invention, and illustrated in Figure 1 of the present application, an artisan of ordinary skill would expect that the MOSFET device disclosed by Floyd et al. would have to be modified to avoid an increase in the ON resistance  $R_{dson}$ . Such modifications would include providing an increased channel width, a reduced channel length, or an enhanced channel with higher hole density at a given gate drive voltage. Indeed, this known concept to reduce channel resistance is illustrated in Figure 1 of the present application.

In accordance with this well-known aspect of MOSFET device construction, Applicant respectfully submits that obtaining a reduced ON resistance in the device of the present invention is an unexpected result, especially in view of the disclosure by Floyd et al. That is, an artisan of ordinary skill would expect that a device constructed according to the disclosure by Floyd et al.

having a reverse polarity type would have a higher ON resistance  $R_{\text{dson}}$  than would the N channel type device disclosed by Floyd et al. Furthermore, an artisan of ordinary skill would anticipate further measures would be necessary to improve the channel resistance for a P-channel device to maintain or lower the higher ON resistance of the P-channel device in comparison with the N-channel device. Indeed, an artisan may consider that such a device may not be worth pursuing because of other anticipated degraded characteristics, such as might be expected for the threshold voltage ( $V_{\text{th}}$ ).

Because the Applicant has succeeded in producing a P-channel type device in which the channel material has a constant concentration along its full length or volume, as is recited in claims 1, 4 and 9 of the present invention, Applicant respectfully submits that the present device exhibits unexpected results that would not be supported or predicted, notwithstanding the device disclosed by Floyd et al. with a reverse polarity type. The constant concentration of the channel material permits a shorter channel than could normally be obtained with a graded doping profile. This construction essentially eliminates the drain resistance normally found in a conventional epi drain device with diffused channel. In addition, Applicant has been able to construct this device without the need of an additional layer and without significant degradation of other operating characteristics.

Applicant further submits that this disclosure of unexpected results is present in the application and described with sufficient detail to provide objective evidence which must be considered by the Examiner. c.f. the tables on pages 3 and 4 of the specification. Applicant notes that the most recent Office Action apparently fails to consider the evidence provided of unexpected results. Instead, the Office Action states that the advantages of the present invention would flow naturally from suggestions in the prior art. Applicant strongly contests this viewpoint and submits that the Examiner ***must consider evidence*** submitted by the Applicant showing unexpected results in a traversal of the rejection. MPEP §716.01(d), In re Odtiker, 24 U.S.P.Q.2d 1443 (Fed. Cir. 1992). Facts established by rebuttal evidence must be evaluated along with the facts on which the conclusion of a *prima facie* case was reached, not against the conclusion itself. In re Eli Lilly, 14 U.S.P.Q.2d 1741 (Fed. Cir. 1990). The statements in the Office Action that the advantages obtained in the present invention would flow naturally from the device disclosed by Floyd et al. with a reverse polarity type are merely the conclusion, and do not take into account an evaluation of the facts in evidence showing unexpected results. Accordingly, Applicant respectfully submits that the rejection of claims 1, 3-6, 8-13 and 20-22 must be properly reevaluated in view of the facts in evidence, which are originally present in the application. Based on this evidence, Applicant respectfully submits that the rejection of the above claims under 35 U.S.C. §103(a) cannot stand, and Applicant respectfully requests that it be reconsidered and withdrawn.

In further support of evidence already provided, Applicant submits with this response a declaration describing the differences in manufacture and operation provided by N and P channel type devices which are the subject of the present invention. In addition, the declaration presents facts showing widespread commercial success of the device that is the subjection of the present application.

In the declaration submitted under 37 C.F.R. §1.132, the declarant, Ritu Sodhi, states that there are significant differences and challenges in the construction and manufacture of P-channel devices according to the present invention, that represent a great deal more than simply reversing the polarity of an N-channel device. For example, the substrate of the P-channel device is Boron-doped and the epi base is Phosphorus-doped. Accordingly, the substrate out-diffusion is different and has to be optimized differently. The declarant states that during the various thermal steps applied to fabricate the P-channel MOSFET, the Boron from the P-channel substrate out-diffuses into the N-type epi region much more readily than the Arsenic from the N-channel substrate of the device disclosed by Floyd et al. Since the MOSFET channel is defined by the epi characteristics, any variation in the out-diffusion directly impacts the blocking capability and the threshold voltage of the device. Hence, there is more control and characterization needed for P-channel MOSFETs if a rugged and stable device is to be produced.

Further, the poly doping process for P-channel devices is done using an implant and drive sequence. Optimization of this implant and doping process is critical not only to maintain a low threshold voltage and gate resistance, but also to minimize the total thermal budget for the process. Accordingly, the use of an epi layer according to the present invention requires design and construction considerations that are not apparent simply from observing an N-channel type device, as alleged in the Office Action.

These considerations, coupled with the challenge of producing a P-channel MOSFET device with a reduced ON resistance  $R_{\text{dson}}$  while having to deal with the lower carrier mobility of holes, results in a number of difficulties with producing the device according to the present invention, as recited in claims 1, 4 and 9, that clearly rise above a simple polarity conversion.

In addition, the declaration contains the sales figures for devices sold incorporating the technology according to the present invention. The declaration makes clear that the devices incorporating the P-channel MOSFET devices according to the present invention are a tremendous commercial success, with sales generating in excess of \$6,000,000 in revenue. These established facts provide clear evidence of commercial success and meeting a long felt need on the basis of the sales data.

In view of the facts presented by the declarant in the attached declaration, Applicant submits that there is abundant evidence of non-obviousness of the present invention over the disclosure of Floyd et al. Accordingly, Applicant respectfully submits that the present invention

is non-obvious over the disclosure by Floyd et al., and all other cited art in the present application. The difficulties associated with constructing a P-channel device according to the present invention make clear that much more than a change in polarity over the device disclosed by Floyd et al. is required. The facts presented by sales data in the declaration clearly illustrate that the present invention meets a long felt need and is highly successful in a commercial sense. These factors, when taken alone certainly provide an excellent case for non-obviousness, and together certainly overcome a *prima facie* case of obviousness.

Accordingly, Applicant respectfully requests reconsideration of the rejection of claims 1, 3-6, 8-13 and 20-22 under 35 U.S.C. §103(a), and that the rejection be withdrawn.

### Conclusion

Applicant respectfully believes that the foregoing is a complete response to all issues raised in the most recent Office Action. This response is believed to place the present application in condition for allowance by clarifying the subject matter that Applicant believes constitutes the invention. Accordingly, in view of the above submissions and discussions, the application is now believed to be in condition for allowance, and notice to that effect is earnestly solicited. The Examiner is respectfully requested to contact the undersigned at the number below, to resolve or further clarify any outstanding issues in the present application.

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as First Class Mail in an envelope addressed to: Asst. Commissioner for Patents, Washington, D.C. 20231, on September 4, 2002: Respectfully submitted,

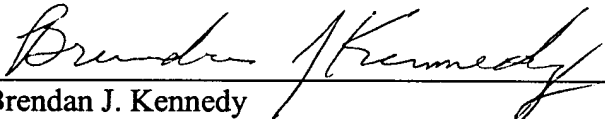
Brendan J. Kennedy

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Name of applicant, assignee or  
Registered Representative

  
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Signature

September 4, 2002

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Date of Signature

  
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Brendan J. Kennedy  
Registration No.: 41,890  
OSTROLENK, FABER, GERB & SOFFEN, LLP  
1180 Avenue of the Americas  
New York, New York 10036-8403  
Telephone: (212) 382-0700

BJK:gl